AMATEUR SATELLITE REPORT

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AMSAT® NA *Newsletter for the Amateur Radio Space Program*

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On-Air Mode S Tests To Begin Soon

AMSAT officials are considering when AO-13 Mode S will be activated. Mode S, a single channel, hard-limited, FM transponder has an uplink at 70 cm and a downlink at 13 cm (2.4 GHz).

Because it has a 70 cm uplink, Mode S must be scheduled concurrent with Mode B which also has a 70 cm uplink. Because of the very narrow beam of the 13 cm Mode S downlink, Mode S must be scheduled for near-apogee when squint angles will be small enough to allow good Mode L reception.

A 1.4 meter (4.6 foot) dish will provide the minimum recommended 28 dBi antenna gain for receiving Mode S. A system noise figure of not worse than 3 dB is believed adequate for Mode S. The Mode S transponder was built by AMSAT-NA by a Colorado team under the leadership of AMSAT veteran Bill McCaa, KØRZ.

Users Give Big Nod To AO-13 As Operations Smooth

Operations on AMSAT OSCAR 13 continued at a brisk pace as the spacecraft enters its third month in orbit. An operating schedule which will be in use until late September has been announced and AMSAT-DL workers continue their efforts to get the RUDAK packet system running. A puzzle is emerging concerning the source of energy pumping up the Mode L receiver AGC to high levels. Tests are under way to determine if one or more terrestrial radars is the source.

AO-13 operations could be characterized as "smooth" with patterns of use now emerging even while new users clamber aboard. Mode B continues to be the most popular with Mode J close behind. Mode L use is growing with every orbit as more users try out their new Mode L equipment. Mode J use will be restricted according to AMSAT-DL.

Testing of the RUDAK continues with AMSAT-DL engineers looking at ways of circumventing a glitch which prevents uplinking operational software. The RUDAK unit installed on a water tower in Munich is being used to model the problem and test possible solutions. Testing will continue for an indeterminate period according to AMSAT-DL.

Suspiciously high Mode L receiver AGC levels have led AO-13 engineers to conduct a series of tests and measurements to determine the source. The prime candidate currently seems to be terrestrial radars operating in the 1.3 GHz range. The radar blanker on Mode L's 24 cm receiver is designed to suppress radar interference.

But preliminary observations suggest the blanker might be getting pelted with more radar energy than it can handle leading to a pumped up AGC. Engineers plan to closely examine the Mode L downlink passband with a spectrum analyzer while AGC levels are high to see if there are any telltale signs of radar pulses in the downlink. These pulses are sufficiently short they cannot be heard on normal receivers with relatively narrow filters. But a spectrum analyzer can view the entire passband and look for pulses and pulse ensembles which would evidence radar being picked up by AO-13's 24 cm Mode L receiver.

DB2OS says one datum which suggests the AGC is being pumped up by a terrestrial source, possibly radar, is that near perigee, when the Mode L receive antenna is looking into space, the AGC is unaffected. But at or near apogee, when the antennas are earth-looking, the AGC is being loaded even though there are few, if any, QSOs in the passband. Another possibility for the AGC activity is some sort of spread spectrum communication energy which would be very difficult to pin down.

Meanwhile, controllers have implemented a modified operating schedule to facilitate testing. Here is the current AO-13 operating schedule. It will remain valid until September 21 and may be deviated from for engineering tests.

[The schedule can be expected to change and may even be modified more frequently than the 2 week *ASR* publication cycle. If we get out of step in *ASR*, we apologize and recommend you tune in to the AMSAT nets for possible schedule updates-Ed]

Revised Operating Schedule: V3.1 19Aug88

Mode	From (Inclus)	Thru (Inclus)	Remarks	Duration MA Minutes
Off	MA 241	MA 002	Solar eclipse window	18 48.3
Mode B	MA 003	MA 099		97 260.2
Mode L	MA 100	MA 150	Mode JL optional	51 136.8
Mode B	MA 151	MA 240		90 241.4
Mode S			Soon	
RUDAK			Testing; ops pending	

The current attitude is approximately BLON = 180, BLAT = 0. On about 19 September, the attitude will be changed to BLON = 210 and BLAT = +5 to respond to seasonal sun angle changes.

Discussions among spacecraft planners and engineers suggest Mode S may be placed on line in a couple of weeks for initial tests. The preliminary discussions have the Mode S transponder on around apogee one day per week. Wednesday is being touted as an experimenter's day during which Mode S might be activated. Mode S, with its 70 cm uplink and 13 cm downlink, cannot be activated concurrent with Mode JL but can operate in conjunction with Mode B. The 13 cm beacon can be activated independent of the other transponders and beacons and will be turned on when the power budget allows and pointing angles permit its reception.

As the average Mode L experience level increases, higher satisfaction levels are evolving. As marginal operating conditions are being avoided and optimum ones are being exploited, perceptions of required uplink power levels are falling. Several stations are regularly active running ten watts and relatively short yagi antennas. Consistent performance does, however, require more uplink power.

Studies which will lead to re-commencement of the ZRO-Test in about a month are under way as well. Watch for an announcement regarding times and frequencies for the first runs on AO-13. An information packet on the ZRO-Test is being updated and will be available soon. The AMSAT Space Education Network should have debuted on September 3 based

on dates assigned at press time.

AMSAT membership is growing nicely based on the success of AO-13. AMSAT HQ says hundreds of new and renewing members have signed up in recent weeks. Many more are expected to join as an expression of satisfaction with AO-13 operations and the special events planned. Many special events will offer special placement for AMSAT members all satellite users are reminded.

So, 3 months after the Phase 3C launch, 3 years after the Phase 3C project began in earnest, 5 years after AO-10 was launched, 8 years after Phase 3A was lost and 12 years after the Phase 3 program began, operations on our first near-Molniya orbit OSCAR are settling in to an atmosphere of familiarity and satisfaction. Users are becoming familiar with its capabilities and are, quite apparently, deeply satisfied and grateful to the organizations and individuals who made it all possible.

AMSAT Director Elections

(Please see ballot card and envelope enclosed)

The following statements have been supplied by the candidates:

Tom Clark, W3IWI—Tom has been active in AMSAT since the OSCAR 6 days. He has been on the AMSAT Board since 1974, was Executive V.P. from 1975-1980 and was Pres. from 1980-1985. He helped develop the Phase 3 telecommand station network. Adaptations of his BASIC satellite prediction program are in use by most active satellite users and has been a major source of revenue for AMSAT. Tom conceived the idea of digital store and forward satellites embodied in the PACSAT, JAS-1 Mode JD and RUDAK projects and coordinated the SAREX-2 shuttle packet radio project. His packet radio bulletin board system serves the Balt./Wash. area and is among the most active in the world. He has successfully coordinated several "big dish" EME sessions and holds the dubious honor of having earned 432 MHz WAC in under 12 hours. Tom is a radio astronomer at NASA/Goddard where he directs a project to measure continental drift using radio telescopes all around the world. Of his contributions to amateur radio, Tom wants to be remembered for two: The "Phoenix from the Ashes" resurrection of AMSAT following the loss of Phase 3A; and, his long-term goal of education.

John Henry, VE2VQ—John, LM-79, is presently a member of the AMSAT Board of Directors. John has been active on satellites since 1974. He was involved with the Doppler position tests that led to the SARSAT/COPAS satellites. John was responsible with feeding the recent Russian/Canadian Ski team with daily positioning once the team had entered Canadian territory. John is a P. Engineer/Manager with Telesat Canada, the domestic satellite carrier and operator of the ANIK satellites. "I would be pleased to serve again on the AMSAT Board using my business, management and technical skills to better AMSAT and its members.

Phil Karn, KA9Q—Phil, an AMSAT Life Member, has been licensed since 1971. He became an AMSAT technical volunteer just after the loss of Phase 3A. With W2FPY, he first studied space radiation effects on computer memories. Phil then turned to the problems of orbit determination and tracking. He spent much of his spare time in 1982-83 developing the computer programs that analyzed Phase 3 orbit alternatives and determined OSCAR 10's new orbit from ranging data after its kick motor firing. (This was also used for OSCAR 13.) For his work Phil received the 1986 AMSAT Technical Achievement Award. Phil contributes to the DSP effort, PACSAT and Phase IV study groups. He has also implemented the DARPA Internet Protocols ("TCP/IP") specifically for free amateur use. He is a member of the TAPR BOD and the ARRL Digital Communications Committee. For the past 5 years he has served as AMSAT's Asst. V.P. for Engineering. Phil holds an MS degree in Computer Engineering from Carnegie Mellon. He is employed by Bellcore as a member of the Technical Staff.

Dough Loughmiller, KO5I—Doug has been a very committed AMSAT volunteer for a number of years. Through his tenure with AMSAT he has held a number of offices including: N. Texas Area Coordinator, Asst. VP of Operations for Spacecraft Operations, VP of Operations and, the office he currently holds, VP of Field Operations. Doug has been actively involved in many different facets of AMSAT management including: convention support, fund raising, information dissemination, public relations and volunteer recruitment. He is a veteran spokesman on AMSAT's behalf with well over 100 public presentations to his credit. He served as a co-primary net control station for the 15 and 20 meter international nets from 1981-84. He currently serves in that capacity on a substitute basis. Doug is very much involved in AMSAT's appearances at major hamfests and conventions. He has directed AMSAT's effort at the Dayton Hamvention on numerous occasions including this year's successful appearance. Doug was honored for outstanding achievement in the area of Field Operations management during the 1987 AMSAT annual meeting in Detroit. Doug was first licensed in 1972 and became an AMSAT member in 1973 while still attending high school. He has been an active satellite enthusiast since OSCAR 6. He has held an amateur extra class license since 1981. He also holds the call sign ZF2IP when on the Cayman Islands. Professionally, Doug is employed by Earth Grains Bread where he has held various management positions over the past 14 years.

Andy MacAllister, WA5ZIB—Andy has been an extremely active AMSAT supporter and life member since OSCAR 7. He holds the positions of AMSAT Awards Manager, editor of the *AMSAT Management Letter* and First Alternate to the Board of Directors. In addition to operation on every satellite mode, Andy devotes time to author HAMSATS column in *73 Magazine* and to publish *OSCAR Notes*, a newsletter for S. Texas satellite enthusiasts. He has written beginners' column in the *AMSAT Satellite Journal* and has been published in *ASR* and *ORBIT* Magazine. Licensed since high school, he holds an extra class ticket. By profession, a hostile-environment electronics design engineer, Andy finds amateur satellite activity the most fascinating and challenging aspect of amateur radio. He has made several thousand satellite contacts, given "how to" talks to local groups and was recognized at the 1985 AMSAT Awards Banquet for his efforts informing amateurs about the ham radio satellites. "As a member of the BOD, I will focus on expanding AMSAT membership and promoting the availability of amateur satellite information for present and future enthusiasts. I would like to see AMSAT continue with dynamic projects like the Phase 4 geostationary satellite program, stay in the forefront of amateur communications and emphasize growth through education and action."

Vern Riportella, WA2LQQ—Rip currently sits on the Board and has served as AMSAT-NA's president since 1985. In this capacity he has been responsible for many projects of keen interest to members. These include the AMSAT News Service (read daily by thousands), AO-13 "First Day Club", AMSAT Launch Information Net Service (ALINS), Video Tape Library, ZRO-Test and the new SatFox Test. He is the founding editor of *Amateur Satellite Report (ASR)* which is in its seventh year. He has served as "Orbit" magazine editor and has written numerous articles for *QST*, *Ham Radio*, *QEX* and *AMSAT Satellite Journal*. He's managed AMSAT's role in two teleconference radio nets, served as AMSAT Net station for six years and continues to provide special satellite broadcasts. Current projects in development include a new videotape news and tutorial service for members and regular special events on AO-13. He says, "My chief concern is that balance be returned to our Board so that I may continue to provide the types of services members have become accustomed to. The members need to make Directors accountable to them. When the Directors are held accountable to the members, I'm certain they'll keep the interest of the members foremost. I'd like to see an increase in member services but need more support from the Board. I hope the members will vote their interests."

Soviet Cosmonaut Dies

by Ed O'Grady, KC2ZF

Veteran Soviet Cosmonaut Anatoly Levchenko died of a brain tumor August 6 the Soviet news agency TASS reported. Levchenko, 47, had been operated on by Soviet doctors but to no avail.

Levchenko, an experienced flight crew member with several missions to his credit, flew most recently to the Soviet Mir Space Station on December 21, 1987 for an 8 day stay. It is believed that he, along with Cosmonaut Igor Volk, was one of the primary pilots in training for the first manned flight of the new Soviet Shuttle. There is speculation that his death may further delay the apparently trouble-plagued program. Soviet space officials have conceded in private they are having trouble developing the space shuttle but have provided few details.

Mr. Levchenko was born in the Ukraine about 435 miles south of Moscow, was an air force test pilot and joined a team of cosmonauts testing space vehicles in 1981, according to TASS.

Surrey Announces New UoSATs

Changes in the NASA/USAF launch manifest have resulted in the postponement of the UoSAT-C mission, originally scheduled for launch on NASA-DELTA in late 1988. However, Surrey has signed final agreements with Arianespace for the launch of two UoSAT satellites into an 800 km, polar, sun-synchronous orbit on Ariane with the SPOT-2 primary payload in early 1989. The Ariane launch opportunity — secured after long negotiations amongst UoSAT, AMSAT-NA and Arianespace — involves a total of seven payloads: SPOT-2 (a replacement for the SPOT-1 imaging satellite), UoSAT-D, UoSAT-E, and four AMSAT-NA Microsats. UoSAT-D and E will now take over the mission objectives of the postponed UoSAT-C mission to support:

- Amateur Radio packet store-and-forward communications transponder,
- studies of the orbital radiation environment,
- in-orbit demonstration and evaluation of novel spacecraft technologies,
- further development of low-cost CCD Earth imaging techniques.

The UoSAT-D and E spacecraft, accompanied by the four AMSAT-NA Microsats, will be placed around a new Ariane structure — the Ariane Structure for Auxiliary Payloads (ASAP) — specially designed to provide small secondary payloads with inexpensive launch opportunities.

The AMSAT-NA payloads include joint projects with Brazil AMSAT, AMSAT-LU and the Center for Aerospace Technology (CAST) at Weber State College, Utah.

Due to mass limitations on the Ariane ASAP, the payloads originally intended for UoSAT-C have had to be split between two spacecraft (UoSAT-D & E). The two UoSAT spacecraft will be structurally identical, and have identical housekeeping subsystems, but will carry different payloads. UoSAT-D will carry an amateur radio digital store-and forward communications transponder operating in the amateur satellite service, and also investigate the effects of the space radiation environment on spacecraft components — funded by the University of Surrey, the Royal Aerospace Establishment (UK), AMSAT-UK and VITA (USA). UoSAT-E will support in orbit technology demonstration and CCD camera experiments.

The primary payload on UoSAT-D will be the Packet Communications Experiment (PCE) which was originally to be carried on UoSAT-C. The PCE is an orbiting packet node with 4 Mbytes of message storage space and advances the work done on UoSAT-2 with the Digital Communications Experiment. The PCE system (hardware and software) is being developed under a contract from the Volunteers In Technical Assistance (VITA), which hopes in the future to use store-and-forward communications as a link with development workers in remote areas. The flight of the PCE on UoSAT-D and its use by radio amateurs will be funded by the University of Surrey and AMSAT-UK.

ALL amateur radio stations with appropriate equipment will have open access to the PCE via AX.25 packet radio. The UoSAT-D PCE will use 9600 bits/sec, frequency-shift-keyed (FSK) uplinks and downlinks. These channels will be compatible with the K9NG-TAPR modem and a new G3RUH modem. The spacecraft will operate in Mode J with the uplink in the 2m band and a downlink in the 70cm band. RF communications links should be good enough to provide a consistent service to groundstations with modest non-steered antennas. An experimental high-power downlink mode for very-small groundstations will also be included.

RUDAK Workers Continue Diagnostic Tests

AMSAT-DL workers report some progress in diagnosing the problem which has affected RUDAK operations. In recent tests they have gathered further evidence the problem is temperature-related.

RUDAK is a packet digipeater developed and built by AMSAT-DL workers in Munich. It is one of four transponders aboard AO-13.

Engineers are currently unable to upload software to the RUDAK because a PROM device is apparently running too cold. Current efforts at a "fix" include heating the RUDAK by activating adjacent modules such as the Liquid Ignition Unit (LIU). RUDAK prognosis is unclear at present.

Officially, AMSAT-DL spokesman will say only the RUDAK group is hard at work attempting to get the software loaded. "RUDAK worked perfectly before launch in Kourou" and an "identical system has been running for nearly 2 years on top of a water tower in Munich, so it's unclear what has happened after launch," according to the spokesman. Testing of RUDAK will continue for an indeterminate period according to AMSAT-DL.

Hints For AO-13 RTTY Reception

by John Gayman, WA3WBU

Copying AO-13's RTTY telemetry is easy and quite popular thanks to the many electronic data boxes now on the market which handle packet, RTTY and CW among their functions. But some AO-13 observers are having difficulty configuring their devices for proper AO-13 RTTY reception.

The biggest problem stems from using the newer multi-mode digital interfaces. Some of these radios have a "vhf" and "hf" mode. Although it seems logical to place them in the "vhf" mode for the AO-13 RTTY beacon, it is not the correct setting.

On most of these units, placing them in the "vhf" mode (packet or RTTY) enables the 1000 Hz shift tone pair. But AO-13's RTTY uses the standard 170 Hz RTTY. Most of the current units have a 200 Hz or "hf" mode. This is the mode to be selected when copying RTTY on the satellite. The slight difference between 200 & 170 Hz shift will not effect operation. So basically the setup procedure should be:

1. RTTY mode
2. 60 wpm or 45 baud [50 baud if available—Ed]
3. HF mode enable (200 Hz shift)
4. Unshift-on-Space OFF or disabled
5. Receiver in upper sideband

Basically the unit, whatever your using, should be set up exactly as it would to copy RTTY on the HF bands, John says.

SEUs Affect TDRSS and OSCARs

According to a report in the authoritative journal "Aviation Week and Space Technology," the Tracking and Data Relay Satellite System (TRDSS) is being upset about twice per day by a phenomenon called "Single Event Upset" or SEU. The result is introduction of memory errors which affect spacecraft operations and data integrity. If an SEU occurs at a critical time, space officials say, it could spell disaster for vital space missions.

The cause of the SEUs is radiation from various sources. The solar wind and cosmic rays are prime sources of the damaging ionizing radiation. The radiation corrupts data stored as minute electric charges in the satellite's computer's Random Access Memory or RAM. The affected memory can be reloaded and, although data will be lost, there appears to be no permanent damage to the RAM which has shown SEU susceptibility.

Officials at Pasadena's Jet Propulsion Laboratory (JPL) are concerned, however, that if an SEU disables TDRSS during a critical phase of an important space mission, failure of that mission could result. One of TDRSS's missions is the relay of telemetry and command/control data to and from satellites in low earth orbits as well as deep-space missions.

Some of the spacecraft using TDRSS, such as interplanetary probes, are highly or mostly autonomous. Failure of TDRSS could cause these missions grave damage. Additionally, the U.S. Shuttle relies on TDRSS for much of its orbit to stay in contact with NASA facilities. A terrestrial network is used as a "gap-filler" and backup.

During past Shuttle missions TDRSS has carried the bulk of scientific data originating in probes and instruments on the Shuttle at rates in the range of hundreds of megabits per second. A TDRSS SEU during Shuttle operations could result in lost data.

AMSAT OSCAR 10's Integrated Housekeeping Unit (IHU) showed many SEUs during its early years of operation. The special error-correcting code used, however, prevented any serious operational problems from arising.

Eventually, however, the NMOS RAM of AO-10's IHU succumbed to total accumulated dose of radiation and suffered a "hard" failure rather than the "soft" failure of the SEU type. A "hard" failure condition is much more serious than the SEUs now affecting TDRSS. A "soft" failure can be corrected by merely re-writing data to the affected cell.

An SEU can be caused by the passage of a charged particle through a RAM cell. If the charge is large enough or the cell dimensions are small enough, the passage of the charge can obliterate the data stored in that cell making a "1" a "0" or vice versa. AMSAT OSCAR 13's memory, on the other hand, is highly resistant to both SEU and total dose so there is no concern regarding its IHU.

The University of Surrey, in an on-going program, is using UoSAT OSCAR

11 as an SEU probe. Surrey says every Wednesday morning, UO-11's DSR memory bank is downloaded via the UHF downlink (435.025 MHz) at 4800 baud. It contains a test pattern, loaded the 18th of July.

Due to cosmic radiation, errors will be introduced in the memory chips. Regular downloading of Bank A will give a good idea of the impact of radiation on the chips. Tests will continue over the next few months. Information on how to participate in the tests may be obtained directly from the University of Surrey.

Space Education Net To Debut September 3

by K.O. Learner, K9PVW, Project Manager

The Space Education Network (SEN) project of AMSAT aims to provide timely information and tutorials on various aspects of space science and communications. This information will help improve individual skills in space communications and encourage a synergistic relationship among Radio Amateurs and those with an abiding interest in space sciences and technologies.

The Space Education Network will begin on AO-13 on Saturday, September 3. The exact times and frequencies will be announced on the AMSAT nets. Sessions on both Mode B and Mode L are planned.

SEN bulletins will cover areas of current news in unmanned space exploration, the space shuttles and space stations and of course, the many amateur space projects underway. Each week will also include a bulletin covering milestones in the history of the Space Age. Tutorial sessions are being planned on topics such as beginning astronomy, space physics, balloon-borne amateur TV and amateur radio astronomy as well as more information on the internal workings of AO-13.

AMSAT encourages all stations to check-in and enjoy the SEN. Your thoughts, ideas and assistance are solicited to make the SEN a successful and enjoyable experience obtained via satellite.

Individual stations are also encouraged to provide gateway operations via local repeaters for the SEN. The bulletin material will begin on the hour and each session will provide time for questions. Gateway operation will be very helpful in bringing the SEN to a large number of amateurs not yet equipped for OSCAR.

The SEN would also like to add SSTV to provide video with the bulletins and tutorials. If you are equipped for SSTV or have any other comments please let us hear from you. Contact K. O. Learner, II, K9PVW at P. O. Box 5006, Kokomo, IN 46904-5006 or by the packet network @KD9QB via W9ZRX.

The SEN will meet Saturdays on both Mode B and Mode L when conditions permit. Times will be announced each week in these bulletins. Exact SEN schedules will vary with satellite availability.

Short Bursts

- Roy, WØSL, says he's updated his popular ORBITS II and ORBITS III tracking program to be compatible with the Kansas City Tracker. There is now a version which uses the math co-processor for higher processing speed, WØSL adds. These programs by WØSL are available from the AMSAT Software Exchange.
- G3IOR reports UoSAT OSCAR 9's 20 meter (14.0014 MHz) HF beacon is being heard for the first time. Better observational techniques by engineers at the University of Surrey are being credited. The beacon is on continuously but a stuck boom/antenna has foreshortened the radiating surface and made a QRP signal more so!
- UA3CR spent some time in the UK discussing packet radio BBS operation. Upon his return home, he promptly placed PBBS UA3CR-2 on the air on 14.099 MHz. It serves as a BBS/Mailbox with VHF links into the Moscow area. The BBS may at times operate under an alternate callsign RA3APR.

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